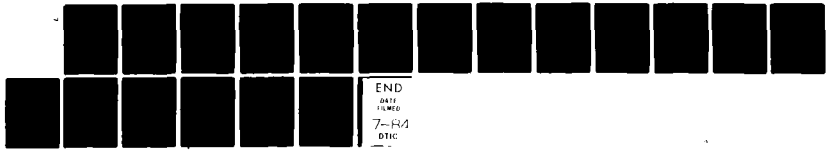
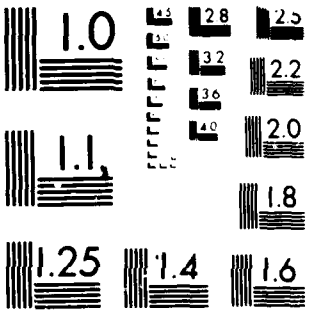
AD-A141 893 TACTICAL ELECTRONIC WARFARE ENVIRONMENT SIMULATOR 1/1
REAL-TIME CONTROL SUBSY..(U) AMHERST SYSTEMS INC
BUFFALO NY E G EBERL JAN 78 N00173-77-C-0105

UNCLASSIFIED F/G 17/4 NL





AMHERST SYSTEMS INC.

TACTICAL ELECTRONIC WARFARE
ENVIRONMENT SIMULATOR

REAL-TIME CONTROL SUBSYSTEM

VOLUME 1

OPERATOR PROCEDURES

JANUARY 1978

Written By:

Dr. Edward G. Eberl
Amherst Systems, Inc.

Written For:

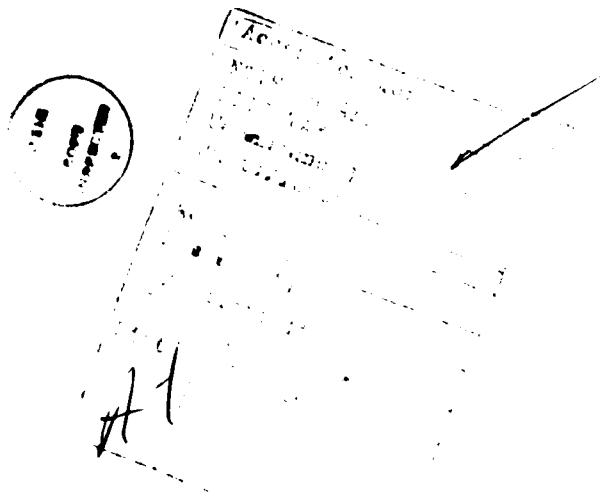
Naval Research Laboratory
455 Overlook Avenue SW
Washington, D. C. 20375

Contract Number N00173-77-C-0105

132 CAYUGA ROAD • BUFFALO, NEW YORK 14225 • 716-631-0610

TABLE OF CONTENTS

Section		Page
1	INTRODUCTION.	1
1.1	System Initialization	1
1.2	Program Initialization.	1
1.3	Data Entry.	3
2	COMMANDS.	4
2.1	Code 1 - Start Scenario	4
2.2	Code 2 - Stop Scenario.	5
2.3	Code 3 - Set Scenario Speed	5
2.4	Code 4 - Radiation Off.	5
2.5	Code 5 - Radiation On	5
2.6	Code 6 - Advance The Scenario	6
2.7	Code 7 - Backup The Scenario.	6
2.8	Code 8 - Initiate Automatic Repeat Loop	6
2.9	Code 9 - Set Pulse Counter Variables.	7
2.10	Code 10 - Set RF Detector Counter Band.	7
2.11	Code 11 - Enable-Disable ~~Dropout~~ Pulse Count Recording	8
2.12	Code 20 - Perform Scenario Event.	8
2.13	Code 30 - Display Emitter Parameters.	12
2.14	Code 99 - End Simulation Run.	12



SECTION 1
INTRODUCTION

The TEWES Control Software is designed to run under Digital Equipment Corporation's RSX-11M operating system. It is written using both the Fortran IV and Macro 11 languages supplied by Digital Equipment. The TEWES Control Software supports all necessary communications between the operator and the digital subsystem and transfers all necessary data from the scenario file to the digital subsystem.

1.1 SYSTEM INITIALIZATION

Before initiating the TEWES Control Software, it may be necessary to power-up the system and load the RSX-11M Executive. Power for the entire Control subsystem is controlled by the main switch on the processor module. After power is switched on, the disks are started by placing both rocker switches in the RUN position. The READY indicators light when the disks are rotating at operating speed.

Loading of the Executive is initiated by typing DK followed by a carriage return on the operator's VT55 CRT console terminal. When the Executive is loaded, it processes some automatic system initialization commands and then prompts the operator to enter the current time and date in a HH:MM:SS MM/DD/YY format. The Executive is now ready to process user commands.

1.2 PROGRAM INITIALIZATION

The realtime software is initiated by entering a RUN OTASK command on the operator's console. When the program is executed, it first must request execution of a support program, which handles the real time operations. If this support program cannot be successfully started, a warning is issued and the program will abort itself. This is a fatal error from which there is no recovery. Should the problem occur, the operating system must be reloaded using the bootstrap procedure.

After the support program has been started the main operator task requests some initialization data before accepting any commands. The data required includes the Maximum Power file name, the Antenna Pattern file name and the Default Threshold file name. Data from these files are read and stored to be output to

the digital subsystem as needed. The data extraction and scenario file names are then input and both files are opened. If either of the files cannot be opened, a warning is issued and both file names must be reentered. If the program is unable to create the data extraction file, it is most likely due to a lack of free space on the device specified. The data extraction file is initially allocated [redacted] contiguous disk blocks. Even if there are more than [redacted] free blocks on a given disk, there still may not be a single contiguous block large enough to create the data extraction file. If sufficient space is not available, the program must be aborted by entering a null data extraction file name, specifying device NL:. This null device can always be accessed, and allows the program to continue to the normal command mode, where the normal exit command must be given immediately.

The system utility PIP can be used to remove any unnecessary files in order to create enough free space. OTASK must then be restarted from the beginning.

When both the data extraction and scenario files have been successfully opened, the operator is prompted to enter the number of the platform containing the EW system, and the frequencies associated with the special sources. Only four frequencies are required, since the other six are fixed and their values are prestored within the program. The four values entered correspond to special channel one, switch positions three and five, and special channel two switch positions one and two. These values are recorded in the data extraction file, as well as the EW system platform number.

This completes the input of initialization data. At this point all events in the scenario with a time of zero are processed. The EW system platform is entered, and linked to emitter number zero and appropriate data is passed to the digital subsystem. The scenario is set to normal speed, and both the [redacted] count and RF detector-counter are set to their default cycle modes as described in Sections 2.9 and 2.10. [redacted] recording is enabled for all active emitters. The radiation is initially turned off, but it will automatically be turned on as soon as the scenario is started the first time. The program is now ready to accept commands from the operator.

1.3 DATA ENTRY

All data entry into the TEWES Control Software is done in an interactive mode. The operator is prompted whenever data are required. Each entry consists of one line containing a single response. Data entry errors can be corrected before the carriage return is input. The DELETE key erases a single character each time it is depressed. Striking a U while the CNTRL key is depressed deletes the entire line of input, but does not clear the screen. The prompt is not repeated, but the cursor is advanced to the next line. Unnecessary spaces should be avoided, as these will be read as zeroes.

Data entry errors can also be corrected after the carriage return. Entering a -12 in response to an input request cancels the current command. A response of -11 causes the program to repeat the previous input request of a command requiring several inputs.

All input values are checked to see that they fall within legal ranges. Illegal responses are rejected and the request is repeated.

SECTION 2

COMMANDS

There are thirteen commands available to the operator to control the real time simulation. If only a carriage return is entered in response to a command request, a list of the valid commands and their command codes is displayed on the operator's console. Commands are given by entering the numeric code corresponding to the desired command. Command codes are as follows.

1	Start Scenario	p. 4
2	Stop Scenario	p. 5
3	Set Scenario Speed	p. 5
4	Radiation Off	p. 5
5	Radiation On	p. 5
6	Advance the Scenario	p. 6
7	Backup the Scenario	p. 6
8	Initiate Automatic Repeat Loop	p. 6
9	Set Counter Variables	p. 7
10	Set RF Detector Band	p. 7
11	Enable-Disable ~~Dropout~~ Recording	p. 8
20	Enter Scenario Events	p. 8
30	Display Emitter Parameters	p. 12
99	End Simulation Run	p. 12

2.1 CODE 1 - START SCENARIO

The Start Scenario command is used to initiate all real time processing. The command has an optional stop time parameter. If a stop time of zero is specified, real time processing will continue until suspended by a Stop, Advance, or Backup Scenario command is issued. If a stop time is specified, real time processing will automatically be suspended when the simulated time reaches the specified value. When the scenario is started, the radiation is turned on unless a radiation off command has been previously issued. Simulated time is periodically advanced according to the scenario speed. Platform positions are updated and emitter bearings and attenuations are calculated and output to the digital subsystem. The position of the EW system platform is periodically output to the

observer. Events from the scenario are processed as simulated time advances.

2.2 CODE 2 - STOP SCENARIO

The Stop Scenario command is used to suspend all real time processing. Simulated time is frozen at its current value, as are all platform positions and emitter bearings and attenuations. The current position of the EW system platform is output to the observer. Although simulated time is frozen, an internal clock still continues to update the elapsed time since the program was initiated. The Stop Scenario command overrides any automatic stop time specified, and cancels any Automatic Repeat Loop command in effect at the time. The scenario speed is not affected.

2.3 CODE 3 - SET SCENARIO SPEED

Command code three is used to modify the scenario speed. It is possible to have simulated time advance at a rate other than actual elapsed time. The new scenario speed is input as a power of two, with the valid speed codes ranging from minus three to three. This allows for scenario speeds in the range from one eighth to eight times normal time. A speed code of zero sets the scenario to normal speed. The Set Scenario Speed command may be issued when the scenario is either running or stopped, and has no effect on any automatic stop time or Automatic Repeat Loop currently in effect.

2.4 CODE 4 - RADIATION OFF

Command code four is used to turn off all RF radiation. When this command is issued, the digital subsystem is commanded to suspend radiation. All real time processing continues and all emitter parameters are kept up to date. Scenario events continue to be processed as simulated time advances.

2.5 CODE 5 - RADIATION ON

Command code five reverses the effects of command code four. The RF radiation is turned on, and all other aspects of the simulation remain unchanged. If the scenario has never been started, the radiation will not actually be turned on

until the scenario is started the first time. Otherwise, the command takes effect immediately.

2.6 CODE 6 - ADVANCE THE SCENARIO

Command code six advances the scenario to the specified time. If the specified time is less than the current simulated time, a warning is issued and no action is taken. This command overrides any automatic stop time or Repeat Loop currently in effect. The radiation is first turned off, and then the simulator is run as fast as possible until the specified simulated time is reached. All platform positions and emitter bearings are updated, and all scenario events up to and including the advance time are performed. When the advance time has been reached, the radiation is turned back on if it was on before the advance command was issued. All real time processing is now suspended and will not be resumed until a Start Scenario or Initiate Automatic Repeat Loop command is given.

2.7 CODE 7 - BACKUP THE SCENARIO

The Backup Scenario command is similar to the Advance Scenario command except that the time specified is less than the current simulated time. If the specified time is greater than the current simulated time, a warning is issued and no action is taken. This command also cancels any automatic stop time or Automatic Repeat Loop currently in effect. The RF radiation is turned off, and all emitters and platforms are deleted from the system. Simulated time is set to zero, and the scenario is processed from the beginning until the target time is reached. All platform positions and emitter bearings and attenuations are updated. When the target time is reached, the RF radiation is turned back on if it was on when the backup command was issued. Real time processing will not resume until a Start Scenario or Initiate Automatic Repeat Loop command is given.

2.8 CODE 8 - INITIATE AUTOMATIC REPEAT LOOP

Command code eight is used to Initiate an Automatic Repeat Loop. Both a start time and stop time are specified. The program determines whether the scenario must be advanced or backed up to the start time, and action is taken as described above for the advance or backup scenario commands. The scenario is automatically

started, and will run until the stop time is reached. The scenario is then automatically stopped, backed up to the start time, and restarted. The program cycles in this fashion until a Stop Scenario, Advance Scenario, or Backup Scenario command is issued. While the repeat loop is being executed, any of the other commands may also be processed. When the scenario is backed up, the scenario speed, counter variables, RF detector band, and dropout status are preserved. These parameters can be set before the initiate automatic repeat loop command is issued, and the values will remain in effect. These values can also be modified once the repeat cycle has been started. However, any operator entered scenario events are lost whenever the scenario is backed up.

2.9 CODE 9 - SET COUNTER VARIABLES

Command code nine is used to define the data to be taken by the individual emitter counters. These counters can be programmed to count the number of pulses output, pulses inhibited by amplitude threshold, pulses dropped due to lack of digital subsystem capacity, or pulses jittered. The program also has the capability of cycling through all four modes automatically. The parameters for the event include a code to specify which counter mode to select, and the periodicity with which the counters are to be read. When the automatic cycle mode is selected, a new counter mode is loaded each time the counters are read, which may be every one, two, or four seconds. The counters are read and cleared, and data is recorded in the data extraction file for all the emitters as selected by the Enable-Disable Dropout Recording command. When the program is initiated, the default condition is the automatic cycle mode, with the counters being read every four seconds.

2.10 CODE 10 - SET RF DETECTOR COUNTER BAND

Command code ten is used to select the RF band to be monitored by the RF detector counter, or specify that the program cycle through all bands. Once per second, the counter is read and reset, and the band number and count value are recorded in the data extraction file. If the cycle mode is selected, the next band number is automatically loaded into the digital subsystem. The initial state is the cycle mode.

2.11 CODE 11 - ENABLE-DISABLE DROPOUT RECORDING

Command code eleven is used to enable or disable dropout recording for a range of emitters. The beginning and end of the range must be input, along with a flag specifying whether the selected emitters are to be enabled or disabled. Although all of the counters are read and cleared together, data are recorded only for active emitters in the range(s) specified. The status of emitters outside the range is not affected. The default condition when the program is initiated is to record data for all active emitters.

2.12 CODE 20 - PERFORM SCENARIO EVENT

Command code twenty allows the operator to manually input any event which can be specified by the scenario. The program prompts the operator to enter each field associated with the specified event. When all necessary data has been input, the event is executed. As the event is executed, the platform or emitter number is checked for validity. If the event cannot be processed, a warning is issued and no action taken. Emitter events are not checked to see that they reference only base emitters in multiple PRI chains. When entering a new emitter, only the base emitter of a multiple PRI chain is checked for availability.

When the operator enters a new platform or makes a motion change on an existing platform, that platform is labeled as an "operator's" platform, and scenario events which attempt to change its motion are ignored. Similarly, when the operator enters a new emitter or turns an existing emitter on or off, that emitter is labeled as an "operator's" emitter and any scenario events which attempt to change its status are ignored. This "operator's" status remains until the end of the simulation run or until the platform or emitter is deleted either by the operator or by a scenario event, or by a Backup Scenario command. Although the operator event is recorded in the data extraction file, it affects only the current run and does not cause a change in the scenario.

The Change Emitter Parameter event is different in that the emitter is not labeled as an "operator's" emitter. Instead, the emitter parameters changed by an operator entered event are fixed and cannot be affected by future scenario events. All

other parameters can still be modified. This fixed status remains in effect until the simulation run is ended, and is not affected when the emitter is deleted either by an operator event, a scenario event, or a Backup Scenario command. This event can also be processed before the specified emitter is entered, and the values input will remain in effect when the emitter is entered either by the Operator or by the scenario. The input format for each of the nine events follows. Units are shown in Table II, Appendix A.

For the Enter New Platform event, the program requests one field at a time including the platform number, position update method, east-west position, north-south position, altitude and heading. If the program update method was specified, the speed and climb rate are requested. Otherwise, all velocity fields are zeroed.

For the Delete Platform Event, all that is required is the platform number. To specify a Velocity Change event, the platform number, heading, speed and climb rate are each requested in turn. Similarly, for the Platform Reposition event the operator is prompted to enter in turn the platform number, east-west position, north-south position, altitude and heading.

The Enter New Emitter event requires the largest number of responses from the operator and is the most complex event. First the emitter and platform numbers are specified. The next field to be entered is a scan type code, which specifies the type of antenna scan to be used, where 1 signifies a standard scan type, 2 signifies a conical scan type and 3 signifies an omnidirectional antenna. If an omnidirectional antenna is specified, beamwidth information is not requested. For either standard or conical emitters, the user is prompted to enter the antenna beamwidth, and a code of 0 or 1 to specify either a unidirectional or bidirectional scan. Since the scan type and beamwidth are combined to determine the actual code placed in the scenario, both fields must be reentered if the -11 backup feature is used to back up once the beamwidth has been entered. To complete the scan data entry, the lower scan sector boundary and the scan sector width are next requested. Then the radiated power, pulse width and pulse jitter values are requested. A priority flag, with 0 signifying low priority and 1 signifying high priority is requested followed by the asynchronous offset and

the number of pulse repitition intervals (PRI's). PRI's are then entered one at a time until the specified number have been input. Utilizing the backup feature while entering PRI's causes the program to move back to the point where the number of PRI's is entered and each PRI must be reentered.

The next field requested is the emitter frequency. Although this field is not stored for special emitters using dedicated special channels, it must always be entered because the frequency agile code and chirp code conversions require a knowledge of the frequency band in use. Next the frequency agility deviation is requested, followed by a code to specify if any special RF channels are to be used, where a code of 1 signifies a special channel is to be used and 0 specifies no special channel is desired. If no special channel is requested, the next value input is the chirp limit.

If a special channel was specified, the RF selection code and the switch position are now requested. The RF selection code is determined from Table III in Appendix A. Codes 1 through 10 are included for reference in determining selection codes when special time-shared channels are used in combination with standard VCO sources. To specify channel 1 time-shared combined with a standard VCO source, add 16 to the VCO number corresponding to the frequency band desired. To specify special channel 2 time-shared combined, add 32 to the VCO number corresponding to the desired band. For both channels 1 and 2 combined, add 48 to the base code number. Note that the special channel dedicated mode is allowed only for emitters having a single PRI. Attempts to specify any other configuration will be rejected, and input data will be requested again. The switch position is entered, and the RF distribution switch position is determined from the VCO number associated with the frequency entered above.

When using timeshared channels combined with standard VCO sources the base VCO number should correspond to the frequency previously entered. Similarly, when using special channels alone, the frequency entered should correspond to the frequency associated with the special source selected by the channel and switch position specified.

If a scan sector width of zero has been specified, the enter new emitter event

is now complete. When the scan sector width is not zero, the scan period must now be entered. The scan return blank flag, with 1 enabling blanking and 0 disabling blanking is input to complete the event.

The Emitter On, Emitter Off, and Delete Emitter events are straight forward, each requiring only the emitter number to be input.

Data entry for the Change Emitter Parameter event is similar to the Enter New Emitter event, except that for a given group code only a portion of the data is required. After the emitter number has been entered, a group code is requested which determines which of five groups of parameters are to be updated. Code one specifies that scan related parameters are to be modified, code two specifies radiated power parameters are to be modified, code three specifies that frequency related parameters are to be modified, code four specifies pulse width and micro jitter are to be modified, and code five specifies that jitter, priority, and PRI data are to be modified.

When scan parameters are to be updated, the program requests in turn the scan type code, beamwidth, directional code, lower scan sector boundary and scan sector width, just as in the Enter New Emitter event. If sector size was set to zero, the event time completes the event. If sector size is not zero, the average PRI and the scan period of the emitter must be input. Although PRI is not a part of this event, it is needed in determining scan rate data from the scan period. For a single PRI emitter, the average PRI is the actual PRI. For multiple PRI emitters, the average PRI is the average of all of the actual PRI's in use. The scan return blank flag completes the event.

For radiated power updates, three fields must be input. The first is the radiated power, entered just as for an Enter New Emitter event. The second is a threshold level below which the digital subsystem will not attempt to output a pulse. This field is not present for the Enter New Emitter event since values are provided by a set of default levels. The Change Emitter Parameter event allows overrides of these default levels.

Group three includes all frequency related data. Frequency, frequency agility deviation and the special channel flag are input as with the Enter New Emitter event. If special sources are to be used, the RF selection code and switch

select code are input. If no special sources are specified then the pulse width and chirp limit are input. Although pulse width is not stored as part of this event, it must be known in order to convert the chirp limit into a chirp rate.

Pulse width and asynchronous offset are specified by group code four. Both these values are entered just as for the Enter New Emitter event, along with the desired event time. Group five includes pulse jitter, the emitter priority flag, the number of PRI's and the individual PRI's. When this event is utilized, each of the PRI's must be entered. It cannot be used to change only one PRI out of a group without reentering the rest of the PRI's in the group. Similar to the Enter New Emitter Event, if the backup feature is used while entering a series of PRI's, the entire string must be reentered.

2.13 CODE 30 - DISPLAY EMITTER PARAMETERS

Command code thirty is used to display all of the parameters associated with a given emitter. After the emitter number has been input, the data stored in the digital subsystem are retrieved and displayed. The actual codes are listed, rather than converting the data back to the input format. Scan sector angles are converted to degrees, but not corrected for scan multiplier effects. In addition to the emitter data, the position and velocity of the associated platform are listed and both the emitter flags and the platform flags are displayed as octal values. The values are decoded into individual flags according to Table I in appendix A. The first emitter linked to the platform, as well as the next linked emitter number are included, so that it is possible to trace through all of the emitters which are linked to a particular platform. A next link field filled will asterisks signifies the end of the chain. Emitter zero is always linked to the EW system platform, allowing its motion to be monitored.

2.14 CODE 99 - END SIMULATION RUN

Command code ninety-nine is used to end the current simulation run. At the next simulated second, all real time processing is stopped. The RF radiation is turned off, the command is recorded in the data extraction file and the file is closed. The program is terminated and control is returned to the RSX-11M Executive.

APPENDIX A

REFERENCE TABLES

TABLE I

PLATFORM FLAGS

FLAG	OCTAL VALUE
EW System Platform	100000
Operator's Platform	40000
Platform is Active	200

EMITTER FLAGS

FLAG	OCTAL VALUE
Group 1 Operator Override	1
Group 2 Operator Override	2
Group 3 Operator Override	4
Group 4 Operator Override	10
Group 5 Operator Override	20
Record Dropouts	200
Dropout Recording Enabled	400
Operator's Emitter	20000
Emitter is On	40000
Next Emitter is Linked PRI	100000

* The Platform Active Flag is true when 0 and false when set. All other Flags are true when set and false when 0.

TABLE II

UNITS

PLATFORM PARAMETERS	UNITS	LEGAL RANGE
East-West Position	Kilometers	-1000. - +1000.
North-South Position	Kilometers	-1000. - +1000.
Altitude	Kilometers	0. - +33.
Speed	Kilometers/Hour	0. - +5000.
Climb Rate	Meters/Second	-180. - +135.

EMITTER PARAMETERS	UNITS	LEGAL RANGE
Beam width	Degrees	0. - +180.
Lower Sector Boundary	Degrees	-360. - +360.
Sector Width	Degrees	0. - +360.
Radiated Power	DBM	0. - +255.
Threshold	DBM	0. - +255
Pulse Width	Microseconds	0. - +102.3
Pulse Jitter	Microseconds	0. - +4095.
Asynchronous Offset	Nanoseconds	0. - +800
Number of PRI's	-	+1 - +240
Pulse Repitition Interval	Microseconds	+2 - +4095
Frequency	Megahertz	+500. - +18,000.
Frequency Agility Deviation	Megahertz	0. - +2000.*
Chirp Limit	Megahertz	*
Scan Period	Seconds	11 - 58
RF Selection Code	-	[illegible]
Switch Select Code	-	[illegible]

* Legal Ranges for these parameters vary in response to other related parameters. Limits are computed as needed as based on the other related fields.

TABLE III

RF SELECTION CODES

CODE	DESCRIPTION
1	.5 -1. GHZ
2	1. -2. GHZ
3	2. -4. GHZ
4	4. -6 GHZ
5	6. -8. GHZ
6	8. -10. GHZ
7	10. -12. GHZ
8	12. -14. GHZ
9	14. -16. GHZ
10	16. -18. GHZ
11	Special Channel 1 Dedicated
12	Special Channel 2 Dedicated
13	Special Channel 1 Time Shared
14	Special Channel 2 Time Shared
15	Special Channel 1 and Special Channel 2


DA
FILM
7